## CLAIMS

**WHAT IS CLAIMED:**

1. A method, comprising:

forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size;

performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size;

illuminating the at least one grating structure;

measuring light reflected off of said grating structure after said etching process is started to generate an optical characteristic trace for said grating structure;

comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile; and

stopping said etching process based upon said comparison of said generated trace and said target trace.

2. The method of claim 1, wherein forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size, comprises forming at least one grating structure in a layer of photoresist material above a scribe line of a wafer, said grating structure being comprised of a plurality of photoresist features of a first size.

3. The method of claim 1, wherein forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size, comprises forming at least one grating structure in a layer of photoresist material above a production die of a wafer, said grating structure being comprised of a plurality of photoresist features of a first size.

4. The method of claim 1, wherein each of said grating structures occupies an area of approximately 100 μm × 120 μm.

5. The method of claim 1, wherein said plurality of photoresist features comprising said at least one grating structure have a pitch ranging from approximately 400-1000 nm.

6. The method of claim 1, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of said at least one grating structure using oxygen as an etchant gas to reduce said photoresist features to a second size that is less than said first size.

7. The method of claim 1, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of said at least one grating structure using oxygen as an etchant gas for a duration of approximately 10-40 seconds to reduce said photoresist features to a second size that is less than said first size.

8. The method of claim 1, wherein measuring light reflected off of said grating structure after said etching process is started to generate an optical characteristic trace for said grating structure comprises measuring a phase and intensity of spectroscopic light reflected off of said grating structure during said etching process to generate an optical characteristic trace for said grating structure.

9. The method of claim 1, wherein measuring light reflected off of said grating structure after said etching process is started to generate an optical characteristic trace for said grating structure comprises measuring a phase and intensity of spectroscopic light reflected off of said grating structure at a plurality of different times after said etching process is started to generate an optical characteristic trace for said grating structure during each said measurement.

10. The method of claim 9, further comprising comparing at least some of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile.

11. The method of claim 10, further comprising stopping said etching process based upon said comparison of said at least some generated traces and said target trace.

12. The method of claim 1, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises comparing said generated optical characteristic trace to a target optical characteristic trace that corre-

sponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprised of a desired critical dimension.

13. The method of claim 1, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile is performed in a scatterometry tool.

14. The method of claim 1, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises stopping said etching process when said generated trace and said target trace match.

15. The method of claim 1, further comprising performing an etching process on a process layer positioned beneath said grating structure after said etching process performed on said photoresist features is stopped.

16. A method, comprising:

forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size;

performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size;

illuminating the at least one grating structure;

measuring light reflected off of said grating structure during said etching process to generate an optical characteristic trace for said grating structure;

comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile; and

stopping said etching process based upon said comparison of said generated trace and said target trace.

17. The method of claim 16, wherein forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size, comprises forming at least one grating structure in a layer of photoresist material above a scribe line of a wafer, said grating structure being comprised of a plurality of photoresist features of a first size.

18. The method of claim 16, wherein forming at least one grating structure in a layer of photoresist material, said grating structure being comprised of a plurality of photoresist features of a first size, comprises forming at least one grating structure in a layer of photoresist material above a production die of a wafer, said grating structure being comprised of a plurality of photoresist features of a first size.

19. The method of claim 16, wherein each of said grating structures occupies an area of approximately 100 μm × 120 μm.

20. The method of claim 16, wherein said plurality of photoresist features comprising said at least one grating structure have a pitch ranging from approximately 400-1000 nm.

21. The method of claim 16, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of said at least one grating structure using oxygen as an etchant gas to reduce said photoresist features to a second size that is less than said first size.

22. The method of claim 16, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of said at least one grating structure using oxygen as an etchant gas for a duration of approximately 10-40 seconds to reduce said photoresist features to a second size that is less than said first size.

23. The method of claim 16, wherein measuring light reflected off of said grating structure during said etching process to generate an optical characteristic trace for said grating structure comprises measuring light reflected off of said grating structure at a plurality of different times during said etching process to generate an optical characteristic trace for said grating structure during each said measurement.

24. The method of claim 23, further comprising comparing at least some of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile.

25. The method of claim 24, further comprising stopping said etching process based upon said comparison of said at least some generated traces and said target trace.

26. The method of claim 16, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprised of a desired critical dimension.

27. The method of claim 16, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile is performed in a scatterometry tool.

28. The method of claim 16, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises stopping said etching process when said generated trace and said target trace match.

29. The method of claim 16, further comprising performing an etching process on a process layer positioned beneath said grating structure after said etching process performed on said photoresist features is stopped.

30. A method, comprising:

forming a plurality of grating structures in a layer of photoresist material, each of said grating structures being comprised of a plurality of photoresist features of a first size;

performing an etching process on said photoresist features of each of said plurality of grating structures to reduce said photoresist features to a second size that is less than said first size;

illuminating said plurality of grating structures;

measuring light reflected off of each of said plurality of grating structures after said etching process is started to generate an optical characteristic trace for each of said plurality of grating structures;

comparing a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile; and

stopping said etching process based upon said comparison of at least one of said generated traces and said target trace.

31. The method of claim 30, wherein forming a plurality of grating structures in a layer of photoresist material, each of said plurality of grating structures being comprised of a plurality of photoresist features of a first size, comprises forming a plurality of grating structures in a layer of photoresist material above a scribe line of a wafer, each of said

plurality of grating structures being comprised of a plurality of photoresist features of a first size.

32. The method of claim 30, wherein forming a plurality of grating structures in a layer of photoresist material, each of said plurality of grating structures being comprised of a plurality of photoresist features of a first size, comprises forming a plurality of grating structures in a layer of photoresist material above a production die of a wafer, each of said plurality of grating structures being comprised of a plurality of photoresist features of a first size.

33. The method of claim 30, wherein each of said grating structures occupies an area of approximately 100 μm × 120 μm.

34. The method of claim 30, wherein said plurality of photoresist features comprising each of said plurality of grating structures have a pitch ranging from approximately 400-1000 nm.

35. The method of claim 30, wherein performing an etching process on said photoresist features of each of said plurality of grating structures to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of each of said plurality of grating structures using oxygen as an etchant gas to reduce said photoresist features to a second size that is less than said first size.

36. The method of claim 30, wherein performing an etching process on said photoresist features of each of said plurality of grating structures to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of each of said plurality of grating structures using oxygen as an etchant gas for a duration of approximately 10-40 seconds to reduce said photoresist features to a second size that is less than said first size.

37. The method of claim 30, wherein measuring light reflected off of each of said plurality of grating structures after said etching process is started to generate an optical characteristic trace for each of said plurality of grating structures comprises measuring a phase and intensity of spectroscopic light reflected off of each of said plurality of grating structures during said etching process to generate an optical characteristic trace for each of said plurality of grating structures.

38. The method of claim 30, wherein measuring light reflected off of each of said plurality of grating structures after said etching process is started to generate an optical characteristic trace for each of said plurality of grating structures comprises measuring a phase and intensity of spectroscopic light reflected off of each of said plurality of grating structures at a plurality of different times after said etching process is started to generate an optical characteristic trace for each of said plurality of grating structures during each said measurement.

39. The method of claim 38, further comprising comparing at least some of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile.

40. The method of claim 39, further comprising stopping said etching process based upon said comparison of said at least some generated traces and said target trace.

41. The method of claim 30, wherein comparing a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises comparing a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprised of a desired critical dimension.

42. The method of claim 30, wherein comparing said plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile is performed in a scatterometry tool.

43. The method of claim 30, wherein comparing said plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises stopping said etching process when at least one of said generated traces and said target trace match.

44. The method of claim 30, further comprising performing an etching process on a process layer positioned beneath said grating structure after said etching process performed on said photoresist features is stopped.

45. A method, comprising:

forming a process layer above a semiconducting substrate;

forming a layer of photoresist material above said process layer;

forming a plurality of photoresist features of a first size in said layer of photoresist material, a first group of said photoresist features comprising at least one grating structure;

performing an etching process on said plurality of photoresist features to reduce said photoresist features to a second size, said second size being less than said first size;

illuminating said at least one grating structure;

measuring light reflected off of said at least one grating structure after said etching process is started to generate an optical characteristic trace for said grating structure;

comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile; and

stopping said etching process based upon said comparison of said generated trace and said target trace.

46. The method of claim 45, wherein forming a process layer above a semiconducting substrate comprises forming a process layer comprised of polysilicon above a semiconducting substrate.

47. The method of claim 45, wherein forming a layer of photoresist material above said process layer comprises forming a layer of positive photoresist material above said process layer.

48. The method of claim 45, wherein forming a layer of photoresist material above said process layer comprises forming a layer of negative photoresist material above said process layer.

49. The method of claim 45, wherein said grating structure is formed above a scribe line of a wafer.

50. The method of claim 45, wherein said grating structure is formed above a production die of a wafer.

51. The method of claim 45, wherein each of said grating structures occupies an area of approximately 100 μm × 120 μm.

52. The method of claim 45, wherein said plurality of photoresist features comprising said at least one grating structure have a pitch ranging from approximately 400-1000 nm.

53. The method of claim 45, wherein performing an etching process on said plurality of photoresist features to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said plurality of photoresist

features using oxygen as an etchant gas to reduce said photoresist features to a second size that is less than said first size.

54. The method of claim 45, wherein performing an etching process on said plurality of photoresist features to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said plurality of photoresist features using oxygen as an etchant gas for a duration of approximately 10-40 seconds to reduce said photoresist features to a second size that is less than said first size.

55. The method of claim 45, wherein measuring light reflected off of said grating structure after said etching process is started to generate an optical characteristic trace for said grating structure comprises measuring light reflected off of said grating structure during said etching process to generate an optical characteristic trace for said grating structure.

56. The method of claim 45, wherein measuring light reflected off of said grating structure after said etching process is started to generate an optical characteristic trace for said grating structure comprises measuring light reflected off of said grating structure at a plurality of different times after said etching process is started to generate an optical characteristic trace for said grating structure during each said measurement.

57. The method of claim 56, further comprising comparing at least some of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile.

58. The method of claim 57, further comprising stopping said etching process based upon said comparison of said at least some generated traces and said target trace.

59. The method of claim 45, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprised of a desired critical dimension.

60. The method of claim 45, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile is performed in a scatterometry tool.

61. The method of claim 45, wherein comparing said generated optical characteristic trace to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises stopping said etching process when said generated trace and said target trace match.

62. The method of claim 45, further comprising performing an etching process on a process layer positioned beneath said grating structure after said etching process performed on said photoresist features is stopped.

63. A method, comprising:

forming a process layer above a semiconducting substrate;

forming a layer of photoresist material above said process layer;

forming a plurality of photoresist features of a first size in said layer of photoresist material to thereby define at least one plurality of grating structures, each of which are comprised of a plurality of said photoresist features;

performing an etching process on said plurality of photoresist features to reduce said photoresist features to a second size, said second size being less than said first size;

illuminating a plurality of said grating structures;

measuring light reflected off of said grating structures after said etching process is started to generate an optical characteristic trace for each of said illuminated grating structures;

comparing each of a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile; and

stopping said etching process based upon said comparison of said generated traces and said target trace.

64. The method of claim 63, wherein forming a process layer above a semiconducting substrate comprises forming a process layer comprised of polysilicon above a semiconducting substrate.

65. The method of claim 63, wherein forming a layer of photoresist material above said process layer comprises forming a layer of positive photoresist material above said process layer.

66. The method of claim 63, wherein forming a layer of photoresist material above said process layer comprises forming a layer of negative photoresist material above said process layer.

67. The method of claim 63, wherein at least some of said plurality of grating structures are formed above a scribe line of a wafer.

68. The method of claim 63, wherein at least some of said plurality of grating structures are formed above a production die of a wafer.

69. The method of claim 63, wherein each of said grating structures occupies an area of approximately 100 μm × 120 μm.

70. The method of claim 63, wherein said plurality of photoresist features comprising each of said grating structures have a pitch ranging from approximately 400-1000 nm.

71. The method of claim 63, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said

photoresist features of said at least one grating structure using oxygen as an etchant gas to reduce said photoresist features to a second size that is less than said first size.

72. The method of claim 63, wherein performing an etching process on said photoresist features of said at least one grating structure to reduce said photoresist features to a second size that is less than said first size comprises performing an etching process on said photoresist features of said at least one grating structure using oxygen as an etchant gas for a duration of approximately 10-40 seconds to reduce said photoresist features to a second size that is less than said first size.

73. The method of claim 63, wherein measuring light reflected off of said grating structures after said etching process is started to generate an optical characteristic trace for each of said grating structures comprises measuring light reflected off of each of said grating structures during said etching process to generate an optical characteristic trace for each of said grating structures.

74. The method of claim 63, wherein measuring light reflected off of said grating structures after said etching process is started to generate an optical characteristic trace for each of said grating structures comprises measuring light reflected off of each of said grating structures at a plurality of different times after said etching process is started to generate an optical characteristic trace for each of said grating structures during each said measurement.

75. The method of claim 74, further comprising comparing at least some of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile.

76. The method of claim 75, further comprising stopping said etching process based upon said comparison of said at least some of said generated traces and said target trace.

77. The method of claim 63, wherein comparing each of a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises comparing each of a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprised of a desired critical dimension.

78. The method of claim 63, wherein comparing each of a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile is performed in a scatterometry tool.

79. The method of claim 63, wherein comparing each of a plurality of said generated optical characteristic traces to a target optical characteristic trace that corresponds to a grating structure comprised of a plurality of photoresist features having a desired profile comprises stopping said etching process when at least some of said generated traces and said target trace match.

80. The method of claim 63, further comprising performing an etching process on a process layer positioned beneath said grating structure after said etching process performed on said photoresist features is stopped.

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